INSTRUCTION MANUAL

REGULATED POWER SUPPLIES

LAMBDA

LAMBDA ELECTRONICS MELVILLE, L. I., N. Y.

INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLIES

Repair Address

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RA

MODEL

LXD-A-152

This manual applies to units
bearing serial no. prefixes A-C

This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics. All information contained herein applies to model LXD-A-152.

LAMBDA ELECTRONICS MELVILLE, L.I., N.Y.
MAIN PLANT TELEPHONE: 516 MYrtyle 4-4200
694-4200

IM-LXD-A

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SPECIFICATIONS AND FEATURES

D.C.OUTPUT - Voltage regulated for line and load. Negative output always tracks positive output. See table I for voltage and current ratings.

TABLE I
VOLTAGE AND CURRENT RANGES

Voltage Range (Volts)	*Maximum Current (Amps) at Ambient Temperature			
	40°C	50°C	60°C	71°C
±12	0.8	0.8	0.7	0.6
±15	1.0	1.0	0.9	0.7

*For current ratings at different output voltages refer to page 2.

Current range must be chosen to suit the appropriate maximum ambient temperature.

REGULATED VOLTAGE OUTPUT (each side)

Regulation (line).....0.1% with input variations from 105-132 or 132-105 volts AC.

Regulation (load).....0.1% for load variations from no load to full load or full load to no load.

Ripple and Noise.....1.5 millivolts rms; 5 millivolts peak to peak

Temperature Coefficient.....Output change in voltage 0.03%/°C.

Remote Sensing.....Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

OVERSHOOT - No overshoot under conditions of power turn-on, turn-off, or power failure.

A.C. INPUT - 105-132 VAC at 47-440 Hz. Ratings apply for 57-63 Hz; at 47-53 Hz 40°C and 50°C ratings do not apply. *Input power: 76 Watts.

*With output loaded to full current rating and input voltage 132 volts AC, 60 Hz.

TRACKING - Absolute voltage difference between negative and positive outputs within 2%; 0.2% change for all conditions of line, load and temperature.

OVERLOAD PROTECTION

Thermal.....Thermal circuit resets automatically when over temperature condition is eliminated.

Electrical.....Automatic electronic current limiting circuit limits output current to a safe value. Automatic current limiting protects the load and power supply when external overloads and direct shorts occur.

INPUT AND OUTPUT CONNECTIONS - Terminal block on rear of chassis.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE - Cintinuous duty from 0°C to 71°C ambient.

STORAGE TEMPERATURE (non operating) - -55°C to 85°C.

OUTPUT ADJUST CONTROL - Voltage adjust control permits adjustment of D.C. output. Single control adjusts both outputs.

PHYSICAL DATA

Size.....3-3/16" x 3-3/4" x 6-1/2"

Weight.....6 lbs: net; 7 lbs. shipping wt.

Finish.....Gray, FED. STD. 595 No. 26081

MOUNTING - Three surfaces, each with tapped mounting holes can be utilized for mounting this unit. All LXD-A power supplies can be mounted with Top, Front or Right Side facing up. Top, Front or Right Side must be in a horizontal plane.

SUFFIX "R" - LXD-A power supplies with suffix "R" are fungus inert.

"V" OPTION - All LXD-A power supplies can be obtained for 205-265 VAC, 47-440 Hz input or 187-242 VAC, 47-440 Hz input. See nameplate for AC input rating. See schematic Diagram for rewiring of AC input. For operation at 47-53 Hz delete 40°C and 50°C ratings.

ACCESSORIES

Rack Adapters.....Rack adapters LRA-4, LRA-6, LRA-8, LRA-10, LRA-11, LRA-12, and LRA-13 used for ruggedized mounting with or without chassis slides are available as well as rack adapters LRA-3 and LRA-5, which are used for simple rack installations where chassis slides are not required.

Overvoltage Protector..Externally mounted, L-20-0V series Overvoltage Protectors are available

Metered and Non-Metered panels.....Metered panels MP-3, MP-5 and Non-Metered panels P-3, P-5 are available for use with Lambda rack adapters LRA-4, LRA-6, or LRA-7.

DETERMINATION OF CURRENT RATINGS AT OUTPUT VOLTAGES BETWEEN ±12 and ±15 VOLTS - Current ratings vary linearly with output voltages. To determine current for any given output voltage (between rated limits) proceed as follows:

1. Determine operating ambient temperature
2. Find constants (see formula) m and c in chart below
3. Applying current formula:

$$Io = m\ Vo + c$$

where Io = output current, m = constant (see chart), c = constant (see chart) and Vo = desired output voltage; determine output current.

Constant m, c at Ambient Temperature

40°		50°		60°		71°	
m	c	m	c	m	c	m	c
0.083	-0.2	0.083	-0.2	0.08	-0.3	0.42	0.1

THEORY OF OPERATION

The theory applies to the plus (+) side of power supply, but is equally applicable to the minus (-) side.

The Lambda power supply consists of an AC input circuit and transformer; and a main regulator circuit consisting of the main rectifier, filter and Hybrid Voltage Regulator. The Hybrid Voltage Regulator (HC1) utilizes thick film resistors, capacitors, monolithic integrated circuits and power regulator transistors in chip form to achieve maximum reliability. The circuit arrangement is shown in block diagram form, figure 5.

Single phase input power is applied to transformer T1 through terminals 1 and 2.

The main rectifier, a full wave rectifier, provides the power which is filtered by capacitor C1 and then regulated via a series regulator located in HC1.

Voltage tracking of the slave section to the master section is accomplished as follows:

When the master output voltage increases, voltage across R2 and R3 also increases, causing an increase in one input to comparator located in HC2. The comparator compares this change with the output voltage of the slave unit resulting in an error signal at the output of the comparator. The error signal from the comparator causes the series regulator (HC2) impedance to decrease, this action increases the slave output voltage.

BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40°C. For continuous operation, load current must not exceed the rating for each ambient temperature. When load exceeds the 40°C rating, both voltage and current decrease until voltage reaches zero and the current at short circuit is reduced to a value which is less than the rated current.

CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying AC input power.

Ground Connections. The Lambda power supply can be operated either with negative, positive, or common terminal grounded. Use insulated wire whenever positive or negative output terminals are connected to terminal 3.

Connection Terminals. Make all connections to the supply at the terminal block on rear of the supply. Apply input power to terminals 1 and 2; always connect the ungrounded (hot) lead to terminal 1.

The supply positive terminal is brought out to terminal 7. The supply negative terminal is brought out to terminal 5. Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 4. Selection of proper wiring is made on the basis of load requirements. Make all performance checks and measurements of current or voltage at the rear output terminals. Connect measuring devices directly to terminals or use the shortest leads possible.

SUPPLY LOAD CONNECTIONS

Connections For Operation as a Constant Voltage Source. The output impedance and regulation of the power supply at the load may change when using the supply as a constant voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing is used. Recommended types of supply-load connections with local or remote sensing are described in the following paragraphs.

Refer to figure 1 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Local Sensing Connections, Figure 3. The three-wire connection, with local sensing is the connection suitable for applications with relatively constant load. Any load connection combination, as shown in the figure, can be used.

Remote Sensing Connections, Figure 4. Remote sensing provides complete compensation for the DC voltage drops in the connecting cables. Sensing leads should be a twisted pair to minimize AC pick-up. A 2.5 mf, elect., capacitor may be required between output terminals and sense terminals to reduce noise pick-up.

THERMAL SHUTDOWN

When the temperature of the internal heat sink exceeds a maximum safe value, the hybrid voltage regulator circuit (HC1 or HC2) reduces the output current to zero. The thermal circuit in HC1, HC2 will automatically reset when the temperature of the heat sink decreases to a safe operating value. The output will cycle on and off to maintain the hybrid at a safe operating temperature. After eliminating the cause(s) for overheating, and allowing time for the power supply to cool to a proper temperature, resume operation of the supply.

MAINTENANCE

GENERAL

This section describes trouble analysis routine and replacement procedures that are useful for servicing the Lambda LXD-A power supply. A trouble chart is provided as an aid for the troubleshooter. Refer to the section on SPECIFICATIONS AND FEATURES for the minimum performance standards.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check primary power lines, external circuit elements, and external wiring for malfunctions before trouble shooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumper and supply-load connections.

Use the electrical schematic diagram and block diagram, figure 5, as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

TROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes, and is used along with the schematic diagram.

The operating conditions assumed for the trouble chart are as follows:

a) AC power of proper voltage and frequency is preset at input terminals

b) Common terminal (terminal 6) is connected to chassis ground.

c) The power supply is connected for constant voltage with local sensing. See schematic; dotted lines indicate jumpers connected for local sensing operation.

TROUBLE SHOOTING CHART

Symptom	Probable Cause	Remedy
1. Zero volts DC output, both sides.	Open T1 primary.	Check T1 primary for open, replace as necessary.
	Short circuit across output of supply.	Check load & load connections, correct as necessary.
	Shorted C1, CR3, CR4, or open CR7.	Check and replace as necessary.
	Series regulator section open.	Check HC1 pins 1-7 for open, replace as necessary.
2. Zero volts DC output, minus side.	Shorted C101, CR103, C104, C3, R3, or open CR107.	Check and replace as necessary.
	Series regulator section open.	Check HC2 pins 1-7 for open, replace as necessary.
3. Unable to adjust output voltage.	Damaged OUTPUT ADJUST control.	Check R1 for open or short, replace as necessary.
4. High ripple at twice line frequency, both sides.	Open C1.	Check and replace as necessary.
5. Same as 4, minus side.	Open C101, C3.	Check and replace as necessary.
6. Same as 4, except intermittent.	Foreign matter fallen into unit.	Check loose bench hardware and wire clippings that may have fallen through cover.
7. Unregulated DC output, both sides.	Open plus sense lead, shorted HC1.	Check sensing connections, check HC1 pins 1-7 for short.

TROUBLE SHOOTING CHART

Symptom	Probable Cause	Remedy
8. Same as 7, minus side.	Open minus sense jumper.	Check connection, correct as necessary.
9. High ripple at line frequency, both sides.	Open CR1 and CR2, or CR5 and CR6.	Check for open, replace as required.
10. Same as 9, minus side.	Open CR101 & CR102, or CR105 & CR106.	Check for open, replace as required.
11. High ripple at other than line frequency.	Defective C4, C104.	Check C4, C104, replace as required.

PERFORMANCE CHECKS

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 6. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC VTVM (John Fluke Model 801H or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the load to no-load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a Variac to vary the line voltage from 105-132 or 132-105 volts AC and check the power supply line regulation accuracy on the VTVM differential meter.

Use a VTVM, Ballantine 320 or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output.

Perform checks on both plus and minus sides of the power supply.

SERVICE

When additional instructions are required or repair service is desired, contact the nearest Lambda office where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components used in the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.

2. Lambda part number.

3. Description of part together with circuit designation.

4. If part is not an electronic part, or is not listed, provide a description, function, and location, of the part.

PARTS LIST

The electrical parts located on Lambda model LXD-A-152 are listed here. In addition, there are separate listings of parts for the "V" option and MP-3, MP-5, P-3, and P-5 accessories.

MODEL LXD-A-152

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C1	Cap., elect., 1,500 mf -10 +100%, 40 vdc	CBS-15-093
C2	Not assigned	
C3	Cap., elect., 3.3 mf ±20%, 35 vdc	CBN-33-019
C4	Cap., elect., 100 mf -10 +75%, 30 vdc	CBR-10-107
C5	Cap., mylar, 0.033 mf ±10%, 400 vdc	CGL-33-009
C6	Cap., mylar, 0.0033 mf ±10%, 200 vdc	CGK-33-003
C101	Same as C1	
C102, C103	Not assigned	
C104	Same as C4	
C105	Not assigned	
C106	Same as C6	
CR1 thru CR3	Rectifier	FBL-00-030
CR4	Not assigned	
CR5, CR6	Same as CR1	
CR7*	Rectifier	FBL-00-092
CR101 thru CR103	Same as CR1	
CR104	Not assigned	
CR105, CR106	Same as CR1	
CR107*	Same as CR7	
HC1	Hybrid Regulator	FBH-24-007
HC2	Hybrid Regulator	FBH-24-008
R1	Res., var., cermet 6,500 ohms ±20%, 1 w	DRS-65-017
R2	Res., film, 8,870 ohms ±½%, 1/8 w	DCS-89-090
R3	Res., film, 2,550 ohms ±½%, 1/8 w	DCS-25-089
R4	Res., comp., 2,200 ohms ±10%, ¼ w	DCB-2221
R5 thru R9	Not assigned	
R10*	Res., comp., 1,000 ohms ±10%, ½ w	DEB-1021
T1	Transformer	ABA-LXDA-152

*CR7 and CR107 only used on units with serial no. prefixes A & B. R10 not used on units with serial no. prefixes A & B.

PARTS FOR "V" OPTION

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
	On model LXD-A-152 with suffix "V", transformer T1 changes and capacitor C5 is removed. Part no. change for T1 is listed here.	
T1*	Transformer	ABA-LXDA-152G

*On units with serial no. prefix A, T1 is ABA-LXDA-152V.

PARTS FOR METERED AND NON-METERED PANEL ACCESSORIES MODELS MP-3, MP-5, P-3, P-5

C1, C2	Cap., tant., 2.5 mf -15 +75%, 100 vdc	CBN-25-010
DS1	Pilot light assembly	HRD-00-007
F1	Fuse, 2A, 3AG, SLO-BLO	FFC-02-000
M1*	Voltmeter, 0-40 vdc	EBP-40-013
M2*	Ammeter, 0-1.5 adc	EDN-15-020
S1**	Switch, SPST	FDA-11-001
S1†	Switch, SPST	FDA-11-040
XF1	Fuseholder	HRK-00-007

*This part only used on MP-3, MP-5
**This part only used on MP-3, P-3
†This part only used on MP-5, P-5

PARTS FOR METERED AND NON-METERED PANEL ACCESSORIES WITH "V" OPTION

On all metered and non-metered panels with suffix "V", fuse F1 changes and a resistor is added in series with pilot light DS1. Parts nos. for F1 and DS1-Res. are listed here.

F1	Fuse, 1A, 3AG, SLO-BLO	FFC-01-000
DS1-Res.	Res., comp., 120,000 ohms ±10%, ½ w	DEB-1241

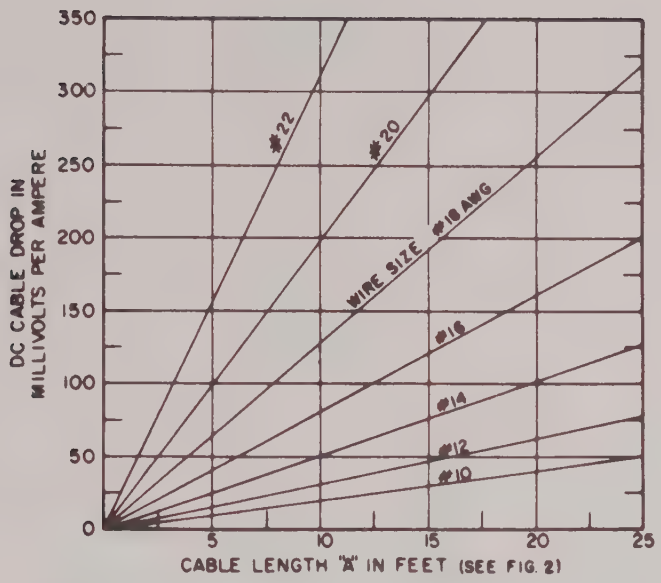


Figure 1. Cable Connection Chart

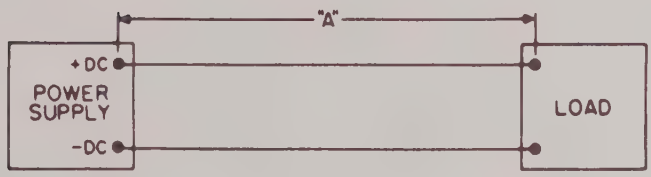
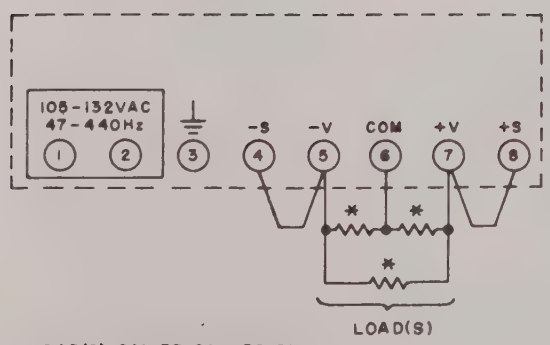
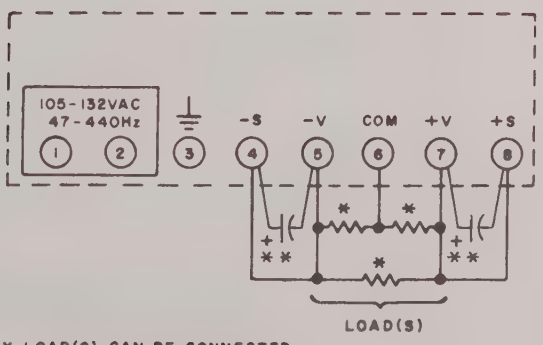


Figure 2. Cable Length "A" in Feet



* LOAD(S) CAN BE CONNECTED IN ANY CONFIGURATION

Figure 3. Local Sensing Connection



* LOAD(S) CAN BE CONNECTED IN ANY CONFIGURATION
** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED

Figure 4. Remote Sensing Connection

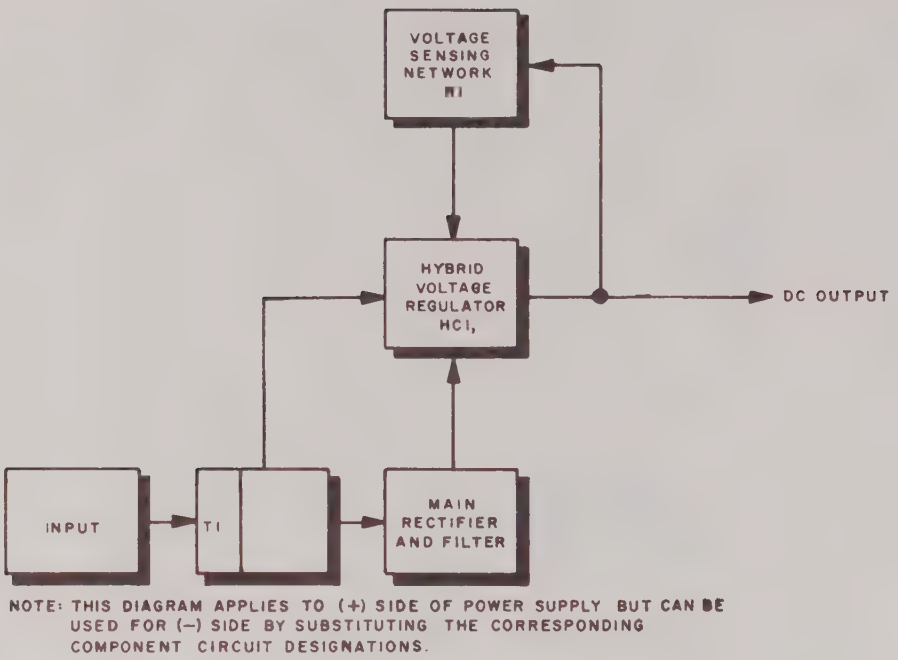

VOLTAGE SENSING NETWORK R1
HYBRID VOLTAGE REGULATOR HC1,
DC OUTPUT
INPUT
T1
MAIN RECTIFIER AND FILTER
NOTE: THIS DIAGRAM APPLIES TO (+) SIDE OF POWER SUPPLY BUT CAN BE USED FOR (–) SIDE BY SUBSTITUTING THE CORRESPONDING COMPONENT CIRCUIT DESIGNATIONS.

Figure 5. Block Diagram

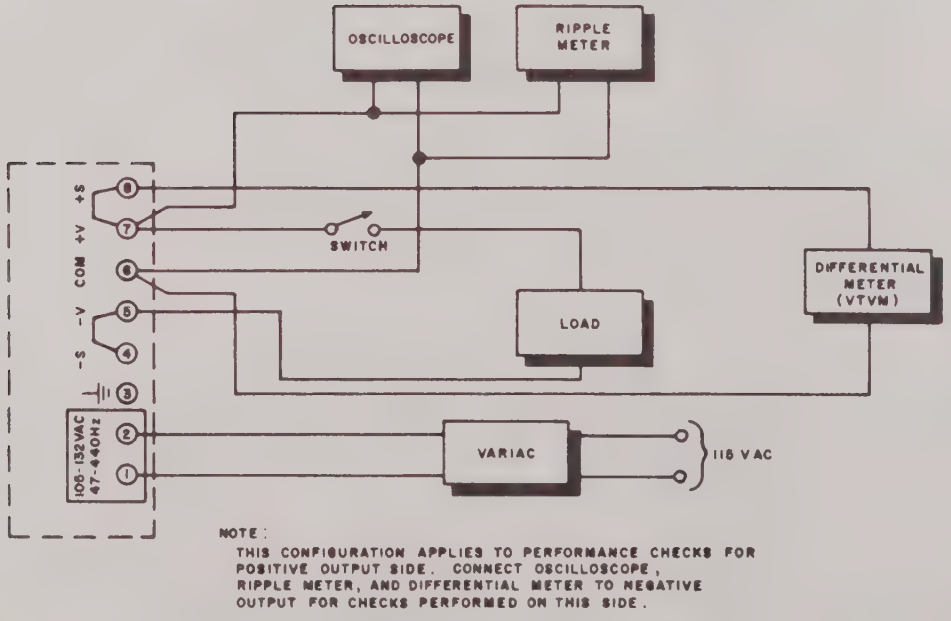


Figure 6. Test Connections For Performance Checks

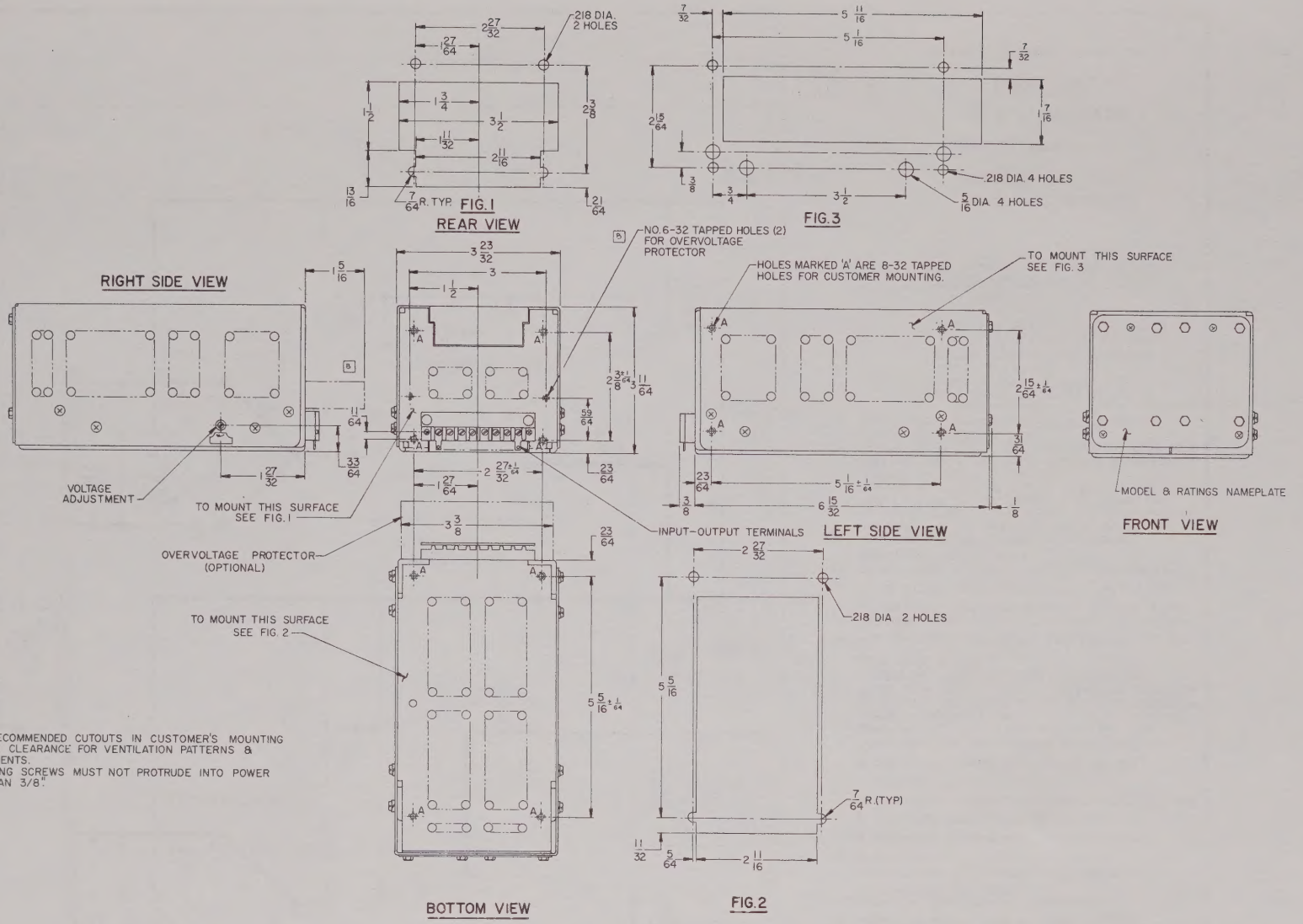
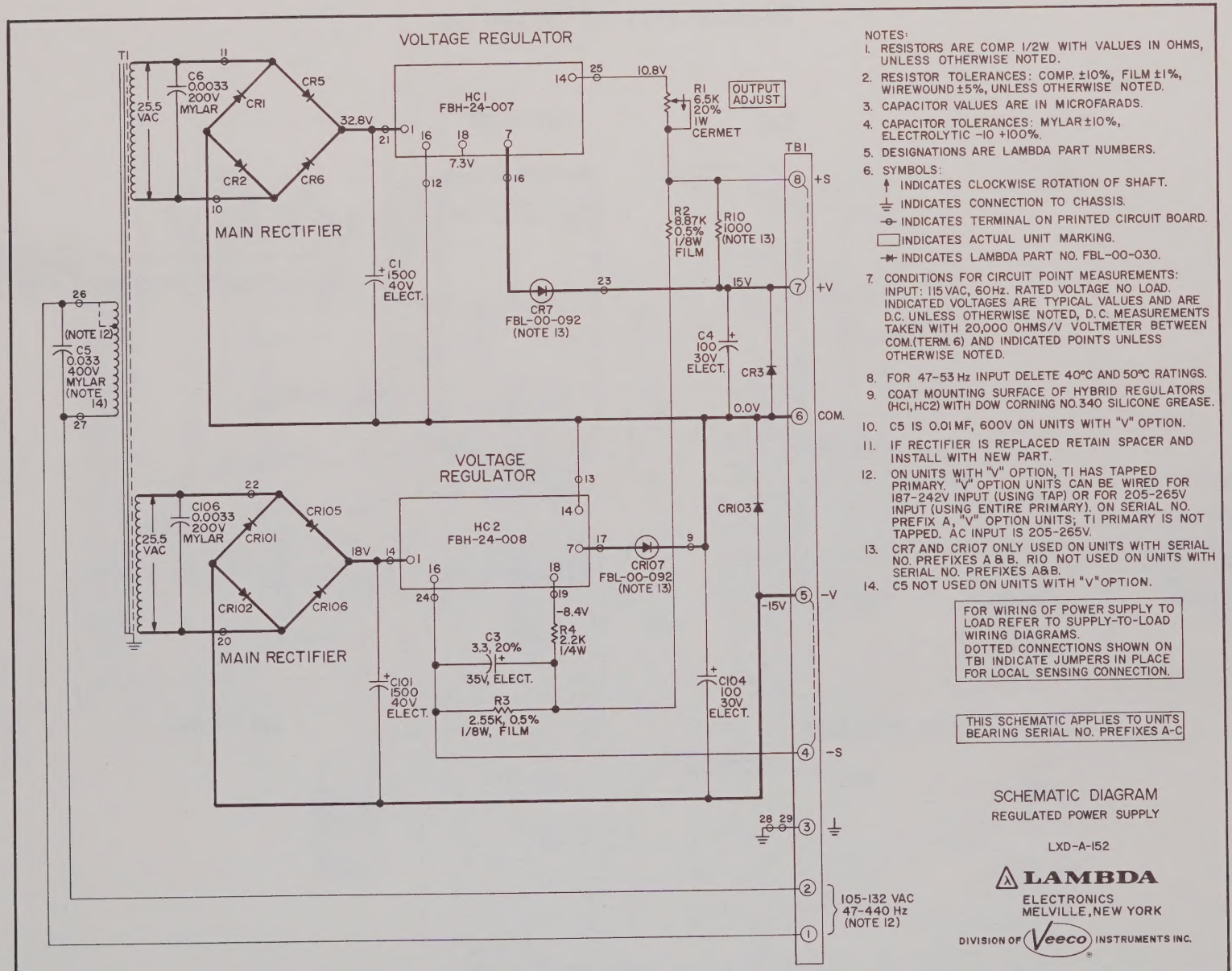


FIG. 1
REAR VIEW
FIG. 3
RIGHT SIDE VIEW
NO. 6-32 TAPPED HOLES (2) FOR OVERVOLTAGE PROTECTOR
HOLES MARKED 'A' ARE 8-32 TAPPED HOLES FOR CUSTOMER MOUNTING.
TO MOUNT THIS SURFACE SEE FIG. 3
VOLTAGE ADJUSTMENT
TO MOUNT THIS SURFACE SEE FIG. 1
INPUT-OUTPUT TERMINALS
LEFT SIDE VIEW
FRONT VIEW
MODEL & RATINGS NAMEPLATE
OVERVOLTAGE PROTECTOR (OPTIONAL)
TO MOUNT THIS SURFACE SEE FIG. 2
BOTTOM VIEW
FIG. 2
NOTES
1. FIGS. 1, 2 & 3 ARE RECOMMENDED CUTOUTS IN CUSTOMER'S MOUNTING SURFACE TO PROVIDE CLEARANCE FOR VENTILATION PATTERNS & PROTRUDING COMPONENTS.
2. CUSTOMER'S MOUNTING SCREWS MUST NOT PROTRUDE INTO POWER SUPPLY BY MORE THAN 3/8".

Figure 7. Outline Drawing



NOTES:

1. RESISTORS ARE COMP. 1/2W WITH VALUES IN OHMS, UNLESS OTHERWISE NOTED.
2. RESISTOR TOLERANCES: COMP. ±10%, FILM ±1%, WIREWOUND ±5%, UNLESS OTHERWISE NOTED.
3. CAPACITOR VALUES ARE IN MICROFARADS.
4. CAPACITOR TOLERANCES: MYLAR ±10%, ELECTROLYTIC −10 +100%.
5. DESIGNATIONS ARE LAMBDA PART NUMBERS.
6. SYMBOLS:
   - ↑ INDICATES CLOCKWISE ROTATION OF SHAFT.
   - ⏚ INDICATES CONNECTION TO CHASSIS.
   - ⊸ INDICATES TERMINAL ON PRINTED CIRCUIT BOARD.
   - ▭ INDICATES ACTUAL UNIT MARKING.
   - ⊣⊢ INDICATES LAMBDA PART NO. FBL-00-030.
7. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60Hz. RATED VOLTAGE NO LOAD. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE D.C. UNLESS OTHERWISE NOTED, D.C. MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN COM.(TERM. 6) AND INDICATED POINTS UNLESS OTHERWISE NOTED.
8. FOR 47-53 Hz INPUT DELETE 40°C AND 50°C RATINGS.
9. COAT MOUNTING SURFACE OF HYBRID REGULATORS (HC1, HC2) WITH DOW CORNING NO.340 SILICONE GREASE.
10. C5 IS 0.01 MF, 600V ON UNITS WITH "V" OPTION.
11. IF RECTIFIER IS REPLACED RETAIN SPACER AND INSTALL WITH NEW PART.
12. ON UNITS WITH "V" OPTION, T1 HAS TAPPED PRIMARY. "V" OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING TAP) OR FOR 205-265V INPUT (USING ENTIRE PRIMARY). ON SERIAL NO. PREFIX A, "V" OPTION UNITS; T1 PRIMARY IS NOT TAPPED. AC INPUT IS 205-265V.
13. CR7 AND CR107 ONLY USED ON UNITS WITH SERIAL NO. PREFIXES A & B. R10 NOT USED ON UNITS WITH SERIAL NO. PREFIXES A&B.
14. C5 NOT USED ON UNITS WITH "V" OPTION.

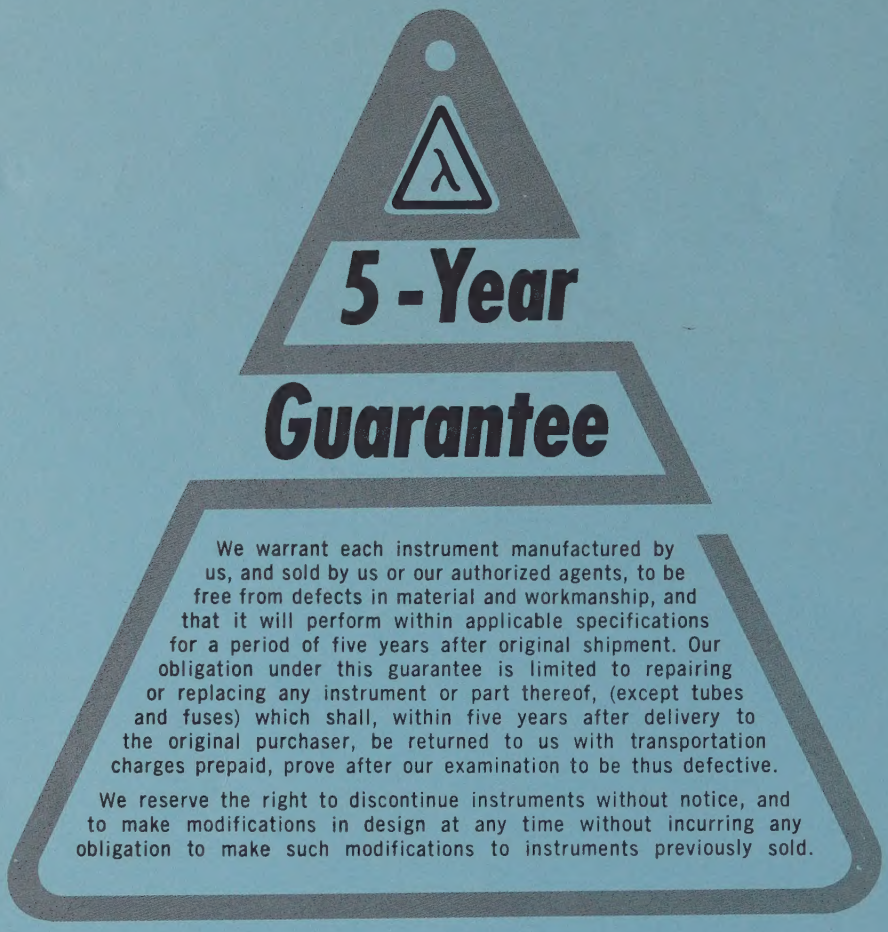
FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.
DOTTED CONNECTIONS SHOWN ON TB1 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIXES A-C

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

LXD-A-152

LAMBDA
ELECTRONICS
MELVILLE, NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.


5 - Year
Guarantee
We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship, and that it will perform within applicable specifications for a period of five years after original shipment. Our obligation under this guarantee is limited to repairing or replacing any instrument or part thereof, (except tubes and fuses) which shall, within five years after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.
We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

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